Jan. 2, 1923. 1,440,937.

F. D. SHEPHERD.

POPPET VALVE FOR INTERNAL COMBUSTION ENGINES.

FILED MAY 10, 1919. 2 SHEETS—SHEET 1.

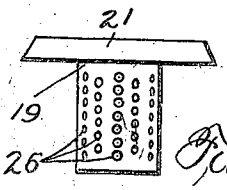


Fig. 2a.

Fig. 2.

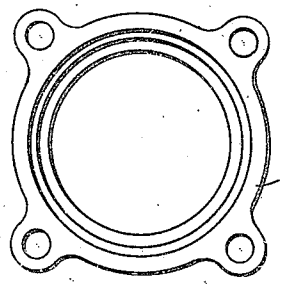
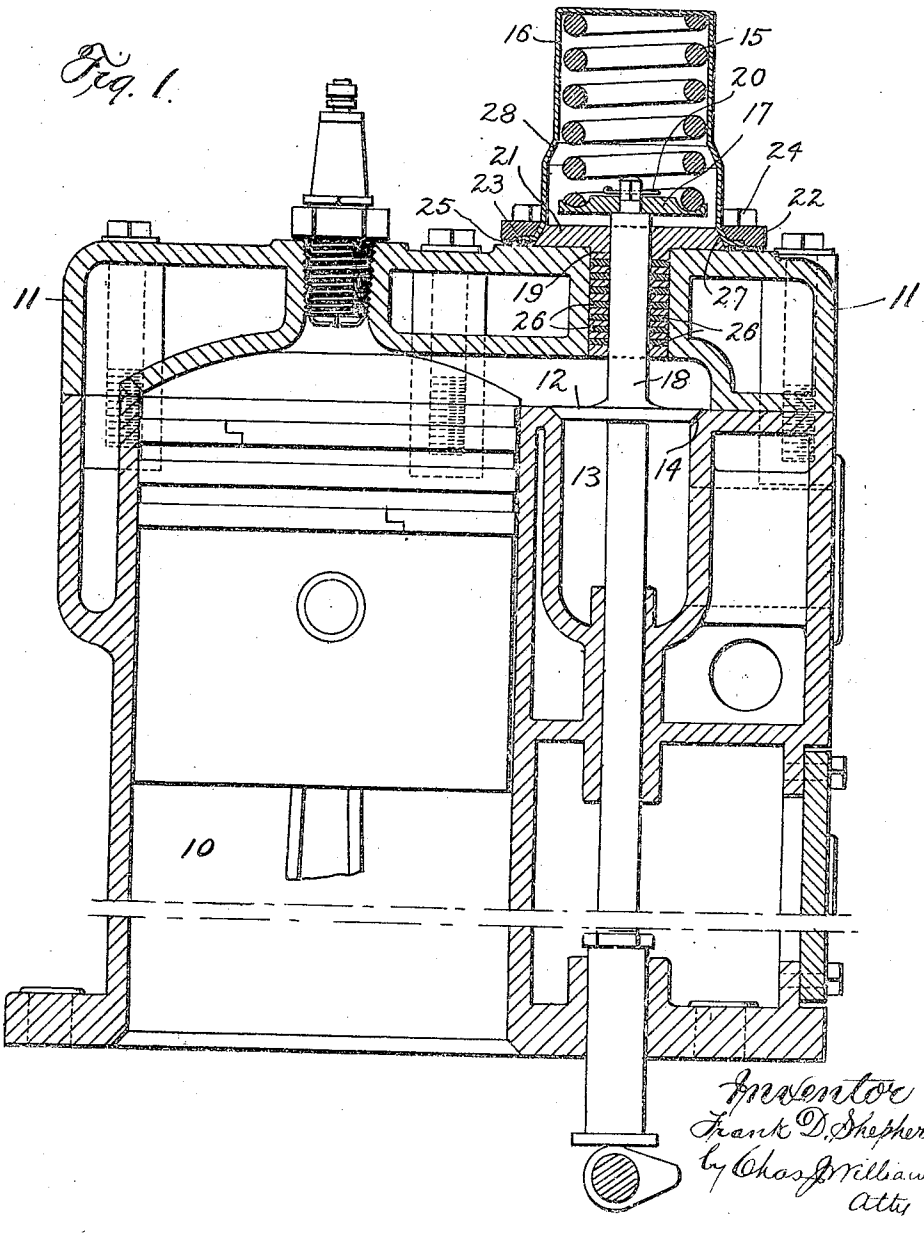


Fig. 1.



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2 SHEETS—SHEET 2.

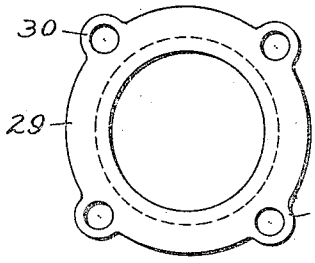


Fig. 4.

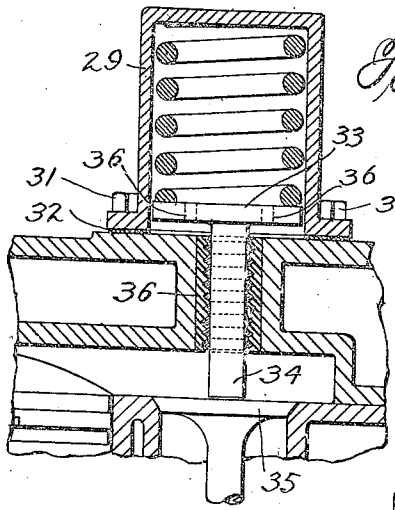


Fig. 3.

Fig. 5.

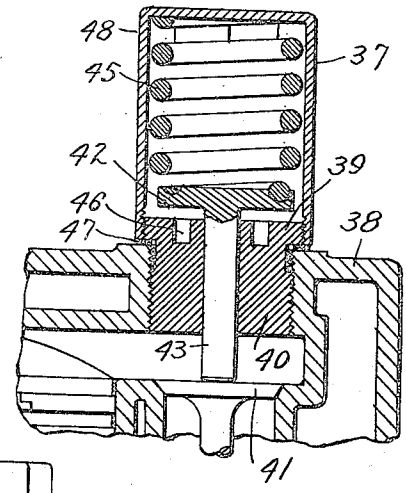
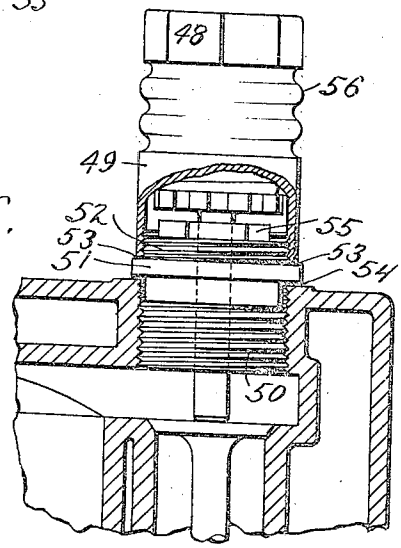


Fig. 6.



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Patented Jan. 2, 1923. 1,440,937

UNITED STATES PATENT OFFICE.

FRANK D. SHEPHERD, OF AURORA, ILLINOIS.

POPPET VALVE FOR INTERNAL-COMBUSTION ENGINES.

Application filed May 10, 1919. Serial No. 296,188.

To all whom it may concern:

Be it known that I, FRANK D. SHEPHERD, a citizen of the United States, residing at Aurora, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Poppet Valves for Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to valves for internal combustion engines, and my object, generally stated, is to make improvements upon valves of the type for which I have obtained patents, having regard to both manufacturing and operating considerations, and which are the result of continued study and investigation of the subject, and will utilize the fundamental principles of the valves of said patents; and my present invention, therefore, consists in the features of construction substantially as hereinafter specified and claimed.

In the annexed drawings which illustrate several forms of my invention—

Fig. 1 is a vertical section illustrating one form of my invention, and adapted to a detachable head engine;

Fig. 2 is a bottom view of the spring container clamping ring, shown in Fig. 1;

Fig. 2ª is a detail view of the bushing;

Fig. 3 is a vertical section showing another form of my invention, also applied to a detachable head engine.

Fig. 4 is a bottom view of the spring container shown in Fig. 3.

Fig. 5 is a vertical section of yet another form of my invention, and applied to an integral head engine.

Fig. 6 is a like view, with parts in elevation, of another embodiment of my invention, also applied to an integral head engine.

Referring particularly to Fig. 1, the engine shown is of a type in which the cylinder 10 has a removable head 11, and a valve 12 that controls a passage or port 13 that leads from the side of the cylinder to the top, or combustion chamber, thereof, the valve being lifted from its seat 14 by a cam and returned and yieldingly held to its seat by a coil spring 15, in a shell or container 16, secured to the top of the engine, the spring bearing at its upper end on the container top and at its lower end upon a disk or head 17 from which a stem 18 extends to the valve, passing with a close, sliding fit through a guide-hole in the engine head, and which guide-hole is in a bushing 19. The stem 18 is integral with the valve 12, and the head 17 separate therefrom and removably seated on the reduced upper end of the stem being confined between the shoulder formed on the stem by the reduction thereof, and a removable pin 20 passing through a hole in the top of the stem protruding above the head 17. The pin 20 prevents the valve falling out when the head is removed from the cylinder. The stem is free to turn in the head 17 so that the valve will be free to revolve and thus avoid contact with its seat always at the same point, and so prevent localized wear. The shell or container 16 is in the form of an inverted cup with its closed end uppermost and its open end downward and attached in a gas-tight manner to the engine head, and thus a chamber is provided that is closed to the atmosphere. Said container is made of sheet metal by stamping or pressing, and it, therefore, can be most inexpensively made, it is light in weight because its walls are thin, and for some uses, as in airplane motors, diminished weight is of great importance, and a further important advantage from thin walls is quickness of heat radiation. As no hole need be provided in the top of the container for the insertion of the spring and disk, requiring to be closed by a plug or cap, saving in cost is effected, and also diminution of projection above the cylinder head is secured. At its lower end the container is centered and supported by fitting over a projection on the head, which may conveniently be a flange 21 on the upper end of the bushing 19, that also serves to fix the position of the latter. As shown in Fig. 1, the container is secured to the head by a ring 22 which overlies an outturned flange 23 on the container, and bolts 24 which pass through holes in the ring and into tapped holes in the cylinder head, the ring being recessed in its underside to receive the flange, so that a single gasket 25 may be placed between the ring and flange and the cylinder head to make a gas-tight joint. The fastening bolts 24 preferably pass outside the container flange to avoid

the necessity of perforating the flange. The bushing 19, is a combination of metal and some frictionless material, such as graphite, in order to reduce friction from the sliding stem 18 to a minimum and thus make the valve exceedingly quick in its seating movement by the spring. As shown in Fig. 1, the bushing wall is perforated with numerous radial holes and the antifriction material 26 is forced into the holes. Since the holes extend crosswise of the direction of sliding motion of the stem 18, any tendency of the latter to displace the lubricant is resisted. And to oppose any upward movement of the bushing from undue gas pressure, I provide a shouldered engagement between the bushing flange and the interior of the container, which preferably, is obtained by slightly tapering the periphery of said flange, and providing a correspondingly inclined surface 27 on the interior of the container, this taper or inclined formation avoiding any objectionable, abrupt bending of the sheet metal.

A sufficient clearance is left between the spring-engaging disk or head 17, shown in Fig. 1, and the adjacent surfaces to allow the passage of air on the movement of the disk, so as to prevent cushioning or retardation thereof, and just above the upper limit of movement of the disk, the container is contracted in diameter in order to form a side support for the coil spring and thereby prevent buckling thereof, the change in diameter being preferably effected by the taper, or crimp 28.

By locating the bolt holes in the container clamping ring 22, as shown in Fig. 2, adjacent containers may be placed very close together.

In the form of my invention shown in Fig. 3, the spring container 29 is of inverted cup-shape and has at its bottom, an outturned flange or ears 30 with holes for bolts 31 that secure it to the engine head, a gas-tight joint being secured by a gasket 32 or a ground joint, and said container may be either of one piece of sheet metal made by die shaping or pressing, or be made by drop forging, or casting, but if drop-forged or cast, its walls will be thin so as to secure the advantages I have heretofore noted. The cast or drop forged form may be preferable to sheet metal as in marine engines, where the engine is subjected to such usage as to require greater strength of walls than sheet metal would afford. In Fig. 3 the spring engaging disk 33 is integral with the stem 34, and the latter is separate from the valve 35, and said stem passes through a bushing 36 of combined metal and anti-friction material, said bushing consisting of a simple sleeve with internal indentations or transversely extending corrugations (which may be a screw thread), filled with graphite or the like, which interlocks or keys with said corrugations so as to prevent displacement by the sliding movement of the stem. To prevent retardation of the disk 33 from air pressure, the disk is provided with several holes 36, for the passage of air.

In the form of my invention shown in Fig. 5, the spring container 37 is made of one piece, in sheet metal, stamped, or pressed, and attached to the engine head 38 (which is integral with the cylinder) by internal screw thread at its lower end which engaged thread on the flange 39 of a plug or bushing 40 screwed into a threaded opening in the head 38, and which is of a diameter for the ready passage of the valve 41, in assembling or taking apart. The disk 42 and its stem 43 are integral, the stem being separate from the valve, as in Fig. 3, but the disk has no air holes, as in Fig. 3, to prevent obstruction to the free movement by air pressure, but instead ample air space is provided between the side of the disk and the interior of the container, and since the latter is cylindrical, the lateral support of the coil spring 45 by the container is provided for making the spring coils above the coil that engages the head, of greater diameter than that coil. The plug or bushing 40, has holes 46 in its top for engagement by a spanner wrench for screwing or unscrewing the plug. To make a gas-tight joint with the engine head, a gasket 47 is placed between the same and the end of the container, and the bottom of the plug flange. For turning the container to screw and unscrew the same, it is provided with flat surfaces 48 at its top.

In Fig. 6 a construction is shown having a sheet metal container 49 and a plug or bushing 50, similar to Fig. 5 but adapted for engines with the plug holes in the head so close as not to permit the use of the container and plug connection shown in Fig. 5. The container 49, instead of screwing on thread on the plug flange 51, is screwed on a threaded, reduced portion 52 on top of the plug, and to secure the desired gas-tight condition, a gasket 53 is placed between the bottom of the container and the flange 51 and a gasket 54 is placed between the flange 51 and the engine head. The plug is provided with a polygonal boss 55 for the application of a wrench, for turning the plug; or, in such cases as the conditions permit, the sides of the flange 51 may be notched or flattened to receive a wrench.

Comparing the construction shown in either Fig. 1 or Fig. 3 with that of Fig. 5, it will be seen that the cooling water in the engine head comes very close to the stem passing through the guide hole in the head, and cools the stem and also the parts forming the container bottom.

The containers, as shown in Fig. 6, may be provided with corrugations 56 to increase the radiating surface, for cooling, and to stiffen the container, and these corrugations may extend circumferentially, as shown in Fig. 6; or longitudinally, or spirally.

Preferably, as shown in the drawings, the spring engaging sides of the heads or disks are grooved or recessed to afford seats for the bottom coils of the springs.

The container walls can be quite thin since it is merely a question of enough tensile strength to withstand the spring pressure, as the spring itself by the effect on the container side walls of its push against the end wall, enables the side walls to resist lateral or sidewise bending; the spring itself thus being an element of strength. I have found that when made of cast metal, the thickness of the container side walls, in a container two inches in diameter, need not be more than substantially a quarter inch, and when I use the term "thin" in my claims, I mean a thickness not greater than substantially a quarter inch in a two inch container; or in that portion of thickness to diameter.

I consider it within the purview of my invention to employ in a given valve mechanism all or any number of the features I show and describe.

What I claim is:—

1. The combination of a gas engine poppet valve, the valve being in the combustion chamber, and its seat, and valve seating means comprising a spring, a metal shell enclosing the spring of cup form with thin integral side and end walls; the end wall receiving an outward thrust from the spring, the open end being closed by an external surface of the engine, and means acted on by the spring reaching from the interior of said shell to the valve through the combustion chamber.

2. The combination of a gas engine poppet valve, the valve being in the combustion chamber, and its seat, and valve seating means comprising a spring, a metal shell enclosing the spring of cup form with thin integral side and end walls, the end wall receiving an outward thrust from the spring, the open end being closed by an external surface of the engine, an outwardly turned flange being provided at such opening and a clamping ring overlying said flange, and means acted on by the spring reaching from the interior of said shell to the valve, through the combustion chamber.

3. The combination in an internal combustion engine, of a valve seat and a movable valve coacting therewith, a container of thin material having an open end, a bushing in the engine having an external flange which fits within the open end of the container, a clamping ring surrounding said open end and gripping the margin of the container against the said flange, valve operating means within the container, and a stem for said valve acted on by the operating means and extending through the bushing.

4. In an internal combustion engine, a cylinder having a valve seat therein, a valve cooperating with said valve seat, a cylinder head having a guide for a stem positioned centrally over said valve seat, a spring acting on said stem to hold the valve in its closed position, a container for said spring positioned centrally over said guide and valve seat, said guide having an anti-friction shank portion fitted into the cylinder head and a head portion extending into said container for locating said container centrally over the valve seat and the guide.

5. The combination in an internal combustion engine, of a valve seat and a movable valve coacting with the seat, a gas-tight container on the engine, a bearing element in the container, resilient means in the container operating against the bearing element, and a stem for transmitting motion from the bearing element to the valve passing with a gas tight sliding fit through an opening leading from the container to the combustion chamber, said container having the portion adjacent the bearing element spaced a sufficient distance from the bearing element to permit free air passage therebetween and confining the outer portion of the resilient means sufficiently to prevent material lateral displacement.

6. The combination in an internal combustion engine, of a valve seat and a movable valve coacting with the seat, a gas-tight container on the engine having its inner portion of greater diameter than its outer portion, a stem for the valve having a head located in the inner portion of the container, and passing with a gas tight sliding fit through an opening leading from the container to the combustion chamber, and a spring guided by the outer smaller portion of the container and bearing against the head.

7. The combination with an internal combustion engine having a removable head and a valve seat, of a valve having a stem slidable in the engine head, means for securing the stem in the head to permit removal of the head from the engine with the valve mounted thereon, a container removably therewith, leaving the valve mounted on the head, said valve seating means normally tending to move the valve in a direction to separate it from the head.

8. The combination with an internal combustion engine having a removable head and a valve seat, of a valve having a stem slidable in the engine head, a bearing disk fastened to the stem and constituting means for securing the stem in the head to permit re-

moval of the head from the engine with the valve mounted thereon, a container removably mounted on the head, and a spring in the container bearing against the disk and detachable therefrom when the container is removed, leaving the valve mounted on the head, said spring normally tending to move the valve in a direction to separate it from the head.

9. An internal combustion engine having a detachable head, a poppet valve, a stem attached thereto passing through a guide hole in the head, a gas-tight container attached to and removable with the engine head and a pressure receiving head in the container, larger than said guide hole secured to the stem against accidental displacement, whereby the valve is prevented falling from the engine head when the latter is separated from the engine and the container is on the head, and means in the container and bearing against the outer side of the head to seat the valve, said valve seating means normally tending to move the valve in a direction to separate it from the head.

10. As an improvement in internal combustion engines, the combination of a poppet valve, a stem attached thereto, a gas-tight container, a pressure-receiving head in the container normally secured to the stem against accidental displacement and a removable head having a guide hole for the stem which hole is of less diameter than said head, whereby said head, stem and valve are prevented from separation from the head when the same is detached from the engine and the container is in place on said head, and a spring in the container bearing against the outer side of the head and removable with the container while leaving the head fastened to the stem, said spring normally tending to move the valve in a direction to separate it from the head.

11. In an internal combustion engine, a cylinder having a valve seat therein, a valve cooperating with said valve seat, a cylinder head, a guide for a stem positioned in said cylinder head centrally over said valve seat, a spring for said stem to hold said valve to its closed position on the valve seat, a thin metal container for said spring inverted centrally over said guide and valve seat, said guide having a portion for locating and holding said container in its central position.

12. In an internal combustion engine, a cylinder having a valve seat therein, a valve cooperating with said valve seat, a cylinder head having a guide for a stem positioned centrally over said valve seat, a spring acting on said stem to hold the valve in its closed position, a container for said spring positioned centrally over said guide and valve seat, said guide having a shank portion fitted into the cylinder head and a head portion extending into said container for locating said container centrally over the valve seat and the guide.

13. In an internal combustion engine, a valve seat, a valve cooperating with said valve seat, a stem for said valve, a disk on the upper end of said stem, a spring acting on said disk to hold the valve to its closed position on the valve seat, a gas-tight container for said spring and disk, said container having an upper portion forming a guide for the spring and a lower portion spaced from the spring and disk to permit the free passage of air and gases around said disk.

In testimony whereof I affix my signature.

FRANK D. SHEPHERD.